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Effect of Chemical Fertilizer and organic manure on quality of maize (*Zea mays* L.)

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Abstract
The present study was carried out during Kharif seasons of 2020-21 and 2021-22 at the Agronomy Research Station and in the laboratory of the College of Agriculture, Bhagwant University, Ajmer, (Rajasthan) India. The soil was low in available nitrogen (195 kg ha^{-1}) and phosphorus (18.5 kg ha^{-1}) and medium in available potassium (229 kg ha^{-1}). Average values for bulk density 1.41 g cc^{-1} and EC were 0.346 ds m^{-1}. The experiment was conducted in split plot design with fifteen treatment combinations. The treatments consisted of three mulching treatments viz. M1-control (no mulch), M2- dust mulch and M3- rice straw mulch (7 t ha^{-1}) in the main plots and five integrated nutrient management levels (S1- 100% RDF, S2- 75% RDF + 25% N through poultry manure, S3- 100% RDF + 25% N through poultry manure, S4- 75% RDF + 25% N through FYM and S5- 100% RDF + 25% N through FYM) in sub plots. The experiment was replicated thrice. RDF use at the rate of 150 kg N 60 kg P and 60 kg K hai^{-1}. Crop response to the treatments was measured in terms of various quantitative and qualitative parameters. For this purpose periodical observation on crop growth characters i.e. plant height, dry matter accumulation and number of leaf was recorded at 25, 50, 75 DAS and at harvest, while leaf area index and chlorophyll content recorded at 25, 50 and 75 DAS and developmental characters 50% days to tasseling and silking was recorded. Yield attributes (final plant stand, cob plant^{-1} , cob length, cob girth, number of grains row cobs^{-1}, number of grain rows^{-1}, grains cob^{-1} , kernel weight cob^{-}1, test weight (gram), yield (grain yield, stover yield and biological yield) and harvest index (%) were recorded at harvest of crop. Similarly N, P and K content and their uptake by grain and stover were estimated. Consumptive use of water, rate of water use and water use efficiency was worked out by adopting standard procedure. Economics of the treatments under study was calculated as per the local market price. Energy parameters were estimated by adopting standard procedure. Standard field techniques, methods of observation, analysis of soil and plant samples and appropriate statistical methods for the analysis of data were used.
Key wards*: Chemical Fertilizer, Organic manure, Quality.*

I. Introduction

Maize (*Zea mays* **L**.) is the world's most important food crop grown in diverse seasons and different ecosystem. It is known as queen of cereals because of its maximum genetic yield potential among food grain. It is also an important industrial raw material and provides opportunity for value addition. It cultivated an area of 9.26 m ha with 16.72 m t production and 3024 kg/ha productivity (Anonymous, 2022). Maize is important source of many industrial products such as corn sugar, corn oil, corn flour, starch, syrup, brewer's grit and alcohol. The increase demand in industrial use of maize as bio-fuel production is likely to create an extra demand for maize in the upcoming decades. With the increase in industrial demand and value-added foods for a growing economy and population, maize would continue to hold its share as a significant crop.

Maize is mainly cultivated in *kharif* season. Rainfall is the major source of moisture to *kharif* maize crops in rainfed conditions but the major constraint is the vagaries of monsoon. Due to moisture stress productivity of maize is reduced (Rana *et al*., 2006) and this could be achieved by conservation of soil moisture and management of other production factors. Therefore, the need for moisture conservation becomes an integral component to embark uponthrough following practice like mulching.

Maize is an exhaustive crop requires large amount of nutrients to gain its full yield potential. In order to meet the nutrient demand of crop farmers are applying a large quantity of imbalanced dose of chemical fertilizers which have a negative effecton soil health, crop yield and also contribute significantly to pollution.

The uptake and partitioning of nutrients to different plant parts depends basically on the fertility status of soil, amount of fertilizers applied, the growth stage of plant, and environmental conditions. In recent past there is a decline in potential factor productivity, even the optimum dose of N, P and K application are failed to maintain the yield level. To sustain the productivity there is a need for nutrient application. But it is observed that continuous use of higher dose of chemical fertilizers alone is not advantageous and leads to a decline pattern in productivity. On this condition, organic source of fertilizers plays a major solution and continuous use

of this leads to enhanced soil humus and soil beneficial microbes besides, improving the soil physical properties and moreover, increases availability of nutrient and use efficiency by regulating the supply of nutrients. But the application of organics alone does not generate spectacular increment in crop yields, because of their low nutrient content while wise mix of natural and inorganic fertilizers assists with keeping up soil health and crop productivity (Kumar *et al.,* 2007).

II. Materials and Methods

The present study was carried out at the Agronomy Research Station and in the laboratory of the College of Agriculture, Bhagwant University, Ajmer, (Rajasthan) India, during 2020- 21 and 2021-22.

The experiment was laid out in a split-plot design with three replications. The mulching treatments were kept in main plots and integrated nutrient management was assigned to sub-plots. The treatments consisted of three mulching treatments *viz.* M_1-control (no mulch), M_2- dust mulch and M_3- rice straw mulch (7 t ha^{-1}) in the main plots and five integrated nutrient management levels (S_1- 100% RDF, S_2- 75% RDF + 25% N through poultry manure, S_3- 100% RDF + 25% N through poultry manure, S_4- 75% RDF + 25% N through FYM and S_5- 100% RDF + 25% N through FYM) in sub plots. The experiment was replicated thrice. RDF use at the rate of 150 kg N 60 kg P and 60 kg K hai^{-1}. Maize variety 'K-99' was sown at row distance of 60x20 cm.

III. Result and Discussion

Among mulching treatments, dust mulch recorded significantly the highest protein content, starch content, lysine content and tryptophan content in maize grain as compared to no mulch and it was statistically at par with rice straw mulch. It may be due to the better soil moisture conditions during plant growth which helped in better utilization of nutrients by the plant, thereby resulting in highest protein, starch, lysine and tryptophan content. The similar results were also reported by Verma *et al*. (2017), Rajput *et al.* (2014), Muhammad *et al*. (2009) and Pinjari (2007).

Amongst integrated nutrient management treatments, highest protein, starch, lysine and tryptophan content in grain was recorded under 100% RDF + 25% N through poultry manure as compared to 75% RDF + 25% N through poultry manure, 75% RDF + 25% N through FYM, 100% RDF and it were at par with 100% RDF + 25 % N through FYM, respectively during both the years. This might be due to adequate availability of nutrients in soil solution as well as higher accumulation of nutrients. Results are corroborated with research findings of Farhad *et al*. (2011), Iqbal *et al*. (2014), Verma *et al*. (2012) and Pinjari (2007). Nagavani and Subbian (2014) reported that application of 50% RDF through poultry manure in combination with 50% RDF through inorganic fertilizer recorded the highest quality parameters of crude protein (12.16%), starch (66.87 mg g-1), reducing sugars (1.13%), total sugars(1.29), Lysine (0.283%) and Tryptophan content (0.077%).

Protein content (%)

Data respect to the protein content in maize grain as influenced by mulching and integrated nutrient management treatments are presented in Table 1. Mulching and integrated nutrient management treatments caused significant variation in protein content in maize grain during both

Table 1: Effect of Mulching and Integrated Nutrient Management on Quality Parameters

Treatments	Protein content (%)		Protein yield (kg ha^{-1})		Starch content (%)		Lysine content (%)		Tryptophan content(%)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
Mulching										
M_1 : Control (No mulch)	10.0	10.2	398	418	52.8	53.2	3.73	3.76	0.753	0.760
M_2 : Dust mulch	11.2	11.4	572	601	59.3	60.2	4.01	4.09	0.824	0.836
M_3 : Rice straw mulch	11.0	11.2	547	580	57.4	58.8	3.82	3.90	0.816	0.828
SEm±	0.1	0.1	13.04	13.04	0.4	0.4	0.03	0.04	0.004	0.005
CD (p=0.05)	**0.3**	**0.3**	**51.19**	**51.20**	**1.4**	**1.5**	**0.13**	**0.14**	**0.015**	**0.018**
Integrated Nutrient Management										
S_1:100% RDF	9.9	10.1	433	450	52.1	53.0	3.73	3.79	0.762	0.778
S_2:75% RDF + 25 % N through poultry manure	10.8	10.9	494	518	56.6	57.4	3.85	3.90	0.802	0.813
S_3: 100% RDF + 25 % N through poultry manure	11.5	11.7	587	615	60.7	61.7	3.96	4.04	0.823	0.834
S_4: 75% RDF + 25 % N through FYM	10.2	10.4	456	489	53.7	54.6	3.77	3.84	0.783	0.793
S_5: 100% RDF + 25 % N through FYM	11.3	11.5	558	593	59.4	60.3	3.96	4.01	0.818	0.822
SEm±	0.1	0.1	13.46	14.49	0.5	0.5	0.04	0.04	0.004	0.005
CD (p=0.05)	**0.3**	**0.3**	**39.30**	**42.30**	**1.3**	**1.4**	**0.12**	**0.12**	**0.013**	**0.014**

the years of investigation. Dust mulch (11.2 and 11.4) recorded highest protein content in maize grain and it was statistically at par with rice straw mulch (11.0 and 11.2) and both are significantly superior over control (no mulch) (10.0 and 10.2) during both the years.

It is evident from the data that all the integrated nutrient management treatments recorded significantly highest protein content in maize grain over 100% RDF. Data further revealed that among integrated nutrient management, the highest protein content in maize grain was recorded under 100% RDF + 25% N through poultry manure (11.5 and 11.7)as compared to 75% RDF + 25% N through poultry manure (10.8 and 10.9), 75% RDF + 25 % N through FYM (10.2 and 10.4), 100% RDF (9.9 and 10.1) and it were at par with 100% RDF + 25% N through FYM (11.3 and 11.5), respectively during both the years. The interaction effect of mulching and integrated nutrient management treatments on protein content in maize grain was found to be non-significant during both the years of investigation.

Starch content (%)

The data in respect of starch content in grain as influenced by mulching and integrated nutrient management treatments are presented in Table 1.

Significantly highest starch content was recorded under dust mulch (59.3 and 60.2) and followed by rice straw mulch (57.4 and 58.8) and lowest in control (no mulch) (52.8 and 53.2), respectively during both the years.

Data further exposed that among integrated nutrient management treatments, significantly the highest starch content was recorded under 100% RDF + 25% N through poultry manure (60.7 and 61.7) as compared to 75% RDF + 25% N through poultry manure (56.6 and 57.4), 75% RDF + 25% N through FYM (53.7 and 54.6), 100% RDF (52.1 and 53.0) and it were at par with 100% RDF + 25% N through FYM (59.4 and 60.3), respectively during both the years.

The interaction effect between mulching and integrated nutrient management treatments on starch content was found to be non-significant during both the years of investigation.

Lysine content (%)

The data pertaining to lysine content of maize as affected by different mulching and integrated nutrient management treatment during both the years of experimentation are presented in Table 1.

Dust mulch (4.01 and 4.09) was recorded significantly highest lysine content followed by rice straw mulch (3.82 and 3.90) and control (no mulch) (3.73 and 3.76), respectively during both the years.

Among integrated nutrient management treatments, highest lysine content was recorded under the 100% RDF + 25% N through poultry manure (3.96 and 4.04) and followed by 100% RDF + 25% N through FYM (3.96 and 4.01) and significantly superior over 75% RDF + 25% N through poultry manure (3.85 and 3.90), 75% RDF + 25% N through FYM (3.77 and 3.84) and 100% RDF (3.73 and 3.79), respectively during both the years. The interaction effect of mulching and integrated nutrient management treatments on lysine content was found to be non-significant during both the years of investigation.

Tryptophan content (%)

Among mulching treatments, dust mulch (0.824 and 0.836) recorded significantly the highest tryptophan content in maize grain as compared to control (no mulch) (0.753 and 0.760) and it was statistically at par with rice straw mulch (0.816 and 0.828), respectively during both the years (Table 1).

Among integrated nutrient management treatments highest tryptophan content in maize grain was recorded under 100% RDF + 25% N through poultry manure (0.823 and 0.834) as compared to 75% RDF + 25% N through poultry manure (0.802 and 0.813), 75% RDF + 25% N through FYM (0.783 and 0.793), 100% RDF (0.762 and 0.778) and it were at par with 100% RDF + 25% N through FYM (0.818 and 0.822), respectively during both the years. The interaction effect between mulching and integrated nutrient management treatments on tryptophan content in maize grain was found to be non-significant during both the years of investigation.

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